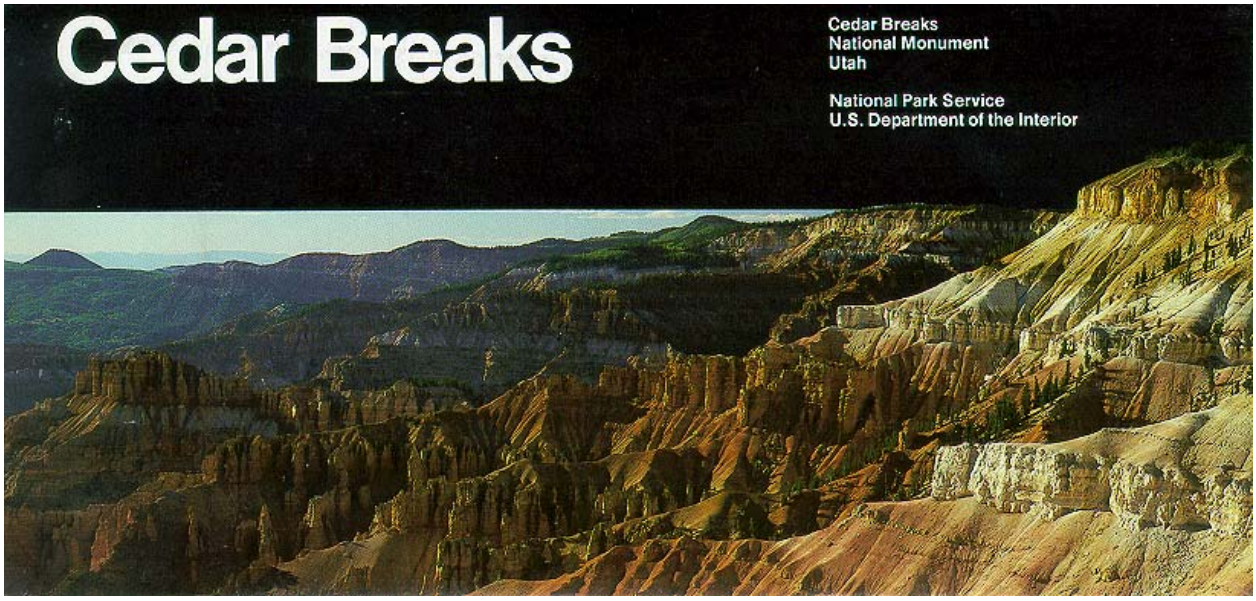

Geologic Resources Inventory Workshop Summary
Cedar Breaks National Monument, Utah
July 15-16, 1999

National Park Service
Geologic Resources Division
and
Natural Resources Information Division

Version: Draft of July 22, 1999

EXECUTIVE SUMMARY

An inventory workshop was held at Cedar Breaks National Monument on July 15-16, 1999 to view and discuss the park's geologic resources, to address the status of geologic mapping by both the Utah Geological Survey (UGS) and the United States Geological Survey (USGS) for compiling both paper and digital maps, and to assess resource management issues and needs. Cooperators from the NPS Geologic Resources Division (GRD), Natural Resources Information Division (NRID), Cedar Breaks NM, UGS, USGS, Southern Utah University, Stockton College, USFS and Utah Bureau of Land Management (BLM) were present for the two-day workshop. (***See Appendix A, Cedar Breaks NM Geological Resources Inventory Workshop Participants, July 15-16, 1999***)

Day one involved a field trip co-led by SUU geology professor Stan Hatfield and USGS geologist Pete Rowley.

Highlights of the field trip can be found at http://www.nature.nps.gov/grd/geology/gri/ut/cebr/field_trip_cebr

Day two involved a scoping session to present overviews of the NPS Inventory and Monitoring (I&M) program, the Geologic Resources Division, and the ongoing Geologic Resources Inventory (GRI) for Colorado and Utah. Round table discussions involving geologic issues for Cedar Breaks NM included interpretation, the UGA Millennium 2000 guidebook featuring the geology of Utah's National and State parks, the status of cooperative geologic mapping efforts, sources of available data, geologic hazards, potential future research topics, and action items generated from this meeting. Brief summaries of each follow.

OVERVIEW OF GEOLOGIC RESOURCES INVENTORY

After introductions by the participants, Steve Fryer (NPS-NRID) presented an overview of the NPS I&M Program, the status of the natural resource inventories, and the geological resources inventory (***see Appendix B, Overview of Geologic Resources Inventory***).

He also presented a demonstration of some of the main features of the **digital geologic map** for the Black Canyon of the Gunnison NM and Curecanti NRA areas in Colorado. This has become the prototype for the NPS digital geologic map model as it ideally reproduces all aspects of a paper map (i.e. it incorporates the map notes, cross sections, legend etc.) with the added benefit of being a GIS component. It is displayed in ESRI ArcView shape files and features a built-in help file system to identify the map units. It can also display scanned JPG or GIF images of the geologic cross sections supplied with the map. The cross section lines (ex. A-A') are subsequently digitized as a shape file and are hyperlinked to the scanned images.

For a recap on this process, go to: http://www.nature.nps.gov/grd/geology/gri/blca_cure/ ***and view the various files in the directory.***

The geologists at the workshop familiar with GIS methods were quite impressed with this method of displaying geologic maps digitally; Joe Gregson is to be commended for his accomplishments.

Bruce Heise (NPS-GRD) followed with an overview of the Geologic Resources Division and the Geologic Resources Inventory.

INTERPRETATION
The GRI also aims to help promote geologic resource interpretation within the parks and GRD has staff and technology to assist in preparation of useful materials including developing site bulletins and resource management proposal (RMP) statements appropriate to promoting geology. Jim Wood (GRD) and Melanie Moreno (USGS-Menlo Park, CA) have worked with several other NPS units in developing web-based geology interpretation themes, and should be considered as a source of assistance should the park desire.

The UGS has the Geologic Extension Services available for help to the NPS for creating interpretive brochures and for seasonal employee training. The UGS also has programs for applied geology (hazards), economic geology, archeology and paleontology. Pete Rowley and Stan Hatfield have generously offered their services and are also available locally for any assistance the park may need regarding geologic issues and interpretation.

UGA GUIDEBOOK ON UTAH'S NATIONAL AND STATE PARK AREAS
Grant Willis of the UGA announced that a guidebook treating the geology of 27 of Utah's national and state parks and monuments would be compiled for publication in September 2000. This compilation will be a snapshot into the geology of each park and covers most facets of what the GRI is trying to develop for each park for a final report (i.e. cross sections, simplified geologic map, general discussions of rocks, structure, unique aspects of park geology, classic viewing localities). The only NPS unit in Utah that will ***not*** be treated will be Golden Spike National Historic Site.

Funding for this publication is coming jointly from the UGA, NPS, BLM, USFS and Utah state parks; it is hoped that the publication will be sold for under $30.

Each author will be *encouraged* to get with NPS staff interpreters to develop a product that aims at a wide audience (the common visitor, the technical audience and the teaching community). Cedar Breaks NM authors will be our field trip leaders (Stan Hatfield, who has also tried to enlist the services of Pete Rowley into the project).

Park authors are strongly encouraged to get with NPS staff to make sure that any trail logs do follow maintained trails and do not take visitors into unauthorized areas, or places where resources are fragile and would be disturbed by increased visitation (i.e. areas with crytptogamic soils).

Also, a CD-ROM will be distributed with the publication featuring road and trail logs for specific parks as well as a photo glossary and gallery. The photo glossary will describe certain geologic features (i.e. *what is crossbedding?*). These will also be available as web-downloadable Adobe Acrobat PDF files. The UGA cannot copyright this material because it is funded with state money, so it can be distributed widely and freely, which will also benefit the purposes of the GRI. Additional reprints are not a problem because

of the digital nature of the publication and the UGA board is committed to additional printings as needed. UGA normally prints 1000 copies of their publications because they become dated after about five years; that will probably not be an issue for this publication. Prices for the full-color guidebook are estimated to be approximately $25/copy, and sales are expected to be high (exact estimates for Capitol Reef NM were 125 copies/year). A website for the guidebook is forthcoming in October 1999.

Field Trips will be held in September 2000. Currently, four field trips are scheduled:
1. Arches NP, Canyonlands NP, Dead Horse Point State Park (SP)
2. Antelope Island SP and Wasatch Mountain SP
3. Zion NP, Cedar Breaks NM, Snow Canyon SP and Quail Creek SP
4. Dinosaur NM, Flaming Gorge NRA, and Red Fleet SP

Note: Trips 1 and 2 will run concurrently and Trips 3 and 4 will also run concurrently.

Many other benefits are anticipated from this publication and are enumerated below:
- This type of project could serve as a model for other states to follow to bolster tourism and book sales promoting their state and its geologic features.

- Sandy Eldredge (UGS) will be targeting teaching communities for involvement in the field trips; hopefully teachers will pass on what they have learned to their young audience.

- The language is intended to appeal to someone with a moderate background in geology and yet will be very informative to the educated geologist.

- The publication may be able to serve as a textbook to colleges teaching Geology of National Parks (in Utah).

- A welcomed by-product could be roadlogs between parks in Utah for those visiting multiple parks, perhaps with a regional synthesis summarizing how the overall picture of Utah geology has developed.

PALEONTOLOGICAL RESOURCES

Dave Sharrow is interested in having a Paleontological Survey conducted for CEBR. Similar studies have been done at Zion, Yellowstone and Death Valley. Vince Santucci (NPS-GRD Paleontologist) needs to be contacted for his input on this matter.

Similar surveys have been done for Yellowstone and Death Valley NP's and have shed valuable new information on previously unrecognized resources. These surveys involve a literature review/bibliography and recognition of type specimens, species lists, and maps (which are unpublished to protect locality information), and also make park specific recommendations for protecting and preserving the resources.

The Death Valley Survey will be available soon. The **Yellowstone** Survey is already available on-line at:
http://www.nature.nps.gov/grd/geology/paleo/yell_survey/index.htm

and is also available as a downloadable PDF at
http://www.nature.nps.gov/grd/geology/paleo/yell.pdf

If a paleontological survey yields significant findings, paleontological resource management plans should be produced for Cedar Breaks involving some inventory and monitoring to identify human and natural threats to these resources. Perhaps someone on the park staff could be assigned to coordinate paleontological resource management and incorporate any findings or suggestions into the parks general management plan (GMP). It would be useful to train park staff (including interpreters and law enforcement) in resource protection, as the fossil trade "black market" has become quite lucrative for sellers and often results in illegal collecting from federal lands.

Collections taken from this area that now reside in outside repositories should be tracked down for inventory purposes. Fossils offer many interpretive themes and combine a geology/biology link and should be utilized as much as possible in interpretive programs.

COOPERATIVE GEOLOGIC MAPPING EFFORTS FOR CEDAR BREAKS NM
UGS Perspective

Currently, the UGS is mapping in Utah at three different scales:

- ***1:24,000*** for high priority areas (i.e. National and State parks)
- ***1:100,000*** for the rest of the state
- ***1:500,000*** for a compiled state geologic map

The availability of funding for Cedar Breaks and Zion (jointly with the NPS) has made it possible for these higher priority areas to be mapped at this detail. The UGS plans to complete mapping for the entire state of Utah within 10-15 years at *1:100,000* scale. For ***1:100,000*** scale maps, their goal is to produce *both* paper and digital maps; for ***1:24,000*** scale maps, the only digital products will be from "special interest" areas (i.e. areas such as Zion and growing metropolitan St. George). Grant Willis mentioned that the UGS simply does not have enough manpower and resources to do more areas at this scale. He also reiterated that UGS mapping goals are coincident with those of the National Geologic Mapping Program.

In Cedar Breaks NM, the UGS has been jointly cooperating with the NPS and USGS for some time on producing these *1:24,000* quadrangles in both paper and digital format. Until 1995, the USGS had done major mapping projects under the BARCO (Basin and Range to Colorado Plateau transition project) mapping program. When the USGS

reorganized, many of these projects were put on indefinite hold. Fortunately, their has been mutual cooperation between the UGS and USGS to work together to get these products completed for the NPS. The NPS appreciates the labor of all involved parties and individuals in this cooperative and hopes that many products will result from the combined efforts of all involved agencies.

The UGS has divided their mapping work in the Cedar Breaks / Zion areas into two distinct phases. The **first phase** involves producing geologic maps for the following quadrangles (***see Appendix C, Cedar Breaks NM Index of Geologic Maps, 1:24,000 Scale)***:

- **The Guardian Angels *(ZION)***
- **Temple of Sinawava *(ZION)***
- **Clear Creek Mountain *(ZION)***
- **Springdale West *(ZION)***
- **Springdale East *(ZION)***

All five quadrangles are field mapped and are presently in the internal review stage by the UGS; some field spot-checking is desirable. Some of the mapping was done using photogrammetric methods and some is hand drawn on Mylar. The UGS expects to deliver *both* completed paper and digital products ***by October 1, 1999***. The original projected deliverable date was April 1, 1999, however, the UGS has had significant turnover with their GIS personnel and has received an extension until October 1st 1999.

The **second phase** began in spring 1999 and will involve geologic mapping for the following quadrangles:

- **Kolob Arch *(ZION)***
- **Kolob Reservoir *(ZION)***
- **Cogswell Point *(ZION)***
- **Completion of Smith Mesa *(ZION)*, The Barracks *(ZION)*, and Navajo Lake *(CEBR)***

The Barracks (southeast of Zion NP) and **Navajo Lake** (south part of Cedar Breaks NM) are already available as published Open File paper maps and will be digitized as part of this phase. Deliverable dates for this phase should be ***September 2001*** according to Grant Willis.

Some issues have surfaced regarding the correlation of Quaternary deposits across quadrangle boundaries which has caused some delay in matching edges between maps of the USGS BARCO project and those of the UGS. The UGS would like to treat these deposits more in-depth.

USGS Perspective

Pete Rowley (USGS) talked about the immense scope of the BARCO project for preparing *1:100,000* scale maps for earthquake potential, mineral resources and

various other themes. Mapping was done at *1:24,000* scale and compiled at *1:100,000* scale. Unfortunately, this project was put on the backshelf because of the USGS 1995 reorganization and many of the original workers have not been able to realize final products for their previous mapping efforts.

Since the USGS now requires digital geologic maps for all of their work, Pete is working with Southern Utah University's (SUU) Dave Maxwell to complete digitizing for some of the BARCO work.

There are many 7.5-minute quadrangles in the BRCA, ZION, and CEBR areas that are in various stages of completion from USGS personnel; Pete Rowley hopes that he will be able to help tidy up some of these unfinished maps and make them ready for publication.

As the park's hydrologist, Dave Sharrow would like to see some emphasis on studying the quadrangles east of Zion for water issues. These include the **Webster Flat** and **Orderville** quadrangles. From his perspective those closest to the Sevier fault are of most interest to him because of a lack of understanding of the hydrology nearest the fault. Pete has done a similar type of project for Nevada test site and would be willing to further discuss this with Dave Sharrow.

Current Status
Two 7.5-minute quadrangles cover Cedar Breaks NM: **Brians Head** to the north, and **Navajo Lake** to the south. **Flanigan Arch** is to the immediate west of Brians Head, and **Webster Flat** is west of Navajo Lake; both are not on NPS land. (***see Appendix C, Cedar Breaks NM Index of Geologic Maps, 1:24,000 Scale)***:

- **Navajo Lake** is published by the USGS as OF (Open File) Report 93-190 entitled "*Preliminary Geologic Map of Navajo Lake Quadrangle, Kane and Iron Counties, Utah*" by David Moore and David Nealey, and was published in 1993. Grant Willis thought that the Quaternary could use some updating, however. Once agreement on the quality of the Quaternary is reached, this quadrangle could be digitized at SUU under the supervision of Pete Rowley. Existing funding is available to digitize this quadrangle under the current agreement between the NPS and UGS for Zion and Cedar Breaks. Grant Willis needs to make sure that digitization at SUU can be contracted through the UGS; he will report back on this. All present thought that this was a good idea, as Pete Rowley would be able to supervise the work out of SUU, and it would serve as a good exercise for SUU, should they receive more of the BARCO quadrangles for digitization.

- **Brians Head** and **Flanigan Arch** are very near completion as Pete Rowley held up drafts of the two quadrangles that Ed Sable had been working on. Ed's deteriorating health, coupled with the collapse of the BARCO project did not allow him to complete these quadrangles. Pete is willing to take over these projects and complete deliverables if funding can be secured. The NPS may be able to secure funding to

complete the Brians Head quadrangle, since it does fall within the Cedar Breaks boundary. It was requested of **Tom Henry** (*CEBR superintendent*) and **Don Falvey** (*ZION superintendent*) that they request the services of Pete Rowley from the USGS to complete the geologic mapping; GRD can assist with writing such a request if they so desire. Pete suggests that Sable remain the senior author and Rowley and Hatfield as co-authors. Rowley would prepare cross-sections, text and do all field checking.

- **Other Miscellaneous loose ends:** Pete prepared a list of other regional quadrangles and categorized them as to the status of field mapping and producing paper maps as "mostly done", "work still needed", and "USGS published quads", as follows:

Mostly done	Work Still Needed	USGS Published Quadrangles
• Flanigan Arch • Brian Head • Red Creek Reservoir • Five Mile Ridge • Summit	• Kolob Reservoir • Cogswell Point • Straight Canyon • Haycock Mountain • Panguitch Lake • Henrie Knolls	• Navajo Lake • Cedar City • Kannarraville • Cedar Mountain • Parowan • Paragonah • Parowan Gap • Cottonwood Mountain • Little Creek Peak • Hatch • Asay Bench

Flanigan Arch and **Webster Flat** are of interest to CEBR and ZION because of the regional watershed, and may be able to be treated as "quadrangles of interest" to the NPS. Again, much preliminary fieldwork has been on these quadrangles by the USGS BARCO team.

Pete Rowley also mentioned that the USGS has agreed to fund the digitization of the **Kanab** *1:100,000* quadrangle through SUU, and hopes to begin overseeing this project in the very near future. Kanab greenlines are also available. The **Panguitch** *100,000* quadrangle has also been digitized by Florian Maldonado (USGS-Denver) in his spare time.

There are some issues to consider in completing these quadrangles:

- Pete would need some financial assistance in digitizing these maps at SUU. Dave Maxwell is willing and able to get a GIS shop going on BARCO projects as he has sufficient equipment and personnel. With Pete's oversight and input, it is hoped that many products may result from the SUU GIS department. Dave Maxwell would also

like to get with the UGS for his input on how to scope out these digital geology projects.

- An EDMAP project may be a good way to obtain assistance for completing any needed field mapping with SUU students

1. Pete's salary and time needs to be covered by the USGS to work on this project. Bruce Heise (NPS-GRD) requested a proposal for Pete Rowley's time to complete the quadrangles of interest to CEBR and ZION that were started under the BARCO project and need some work to produce final products. It may be possible to tap into the National Mapping program to obtain financial assistance here. A two-tier proposal was suggested: ***first*** just to complete Brian Head, and ***second*** to include the western quadrangles (Flanigan Arch and Webster Flat) with Brian Head.

- Other surficial specialists (*Van Williams was mentioned*) may need to be called upon to help complete the surficial mapping and caliche deposits; also numerous landslides are known for the area and should be mapped appropriately. Salary and time is also an issue for these specialists.

- A priority list for quadrangles of interest should be developed for SUU and estimates of costs and time to complete the work also need to be ascertained. Grant Willis suggested that a few weeks for a single quadrangle seems like a reasonable amount of time.

OTHER SOURCES OF NATURAL RESOURCES DATA FOR CEDAR BREAKS NM

- The UGS has a significant quadrangle database that they have furnished to NRID for the entire state of Utah.

- NRID has compiled a geologic bibliography for numerous parks and monuments, including Cedar Breaks. Visit the website at: http://165.83.36.151/biblios/geobib.nsf; **user id** is "*geobib read*", **password** is "*anybody*".

- The USGS has compiled large volumes of data on the BARCO project that was halted in 1995; much of this work is unpublished and should be sought out from USGS personnel.

- Dave Sharrow was asked if CEBR currently has their ProCite software in place that chronicle any natural resources into a bibliography. Dave wasn't sure, and thought that Steve Robinson would know for sure. Steve needs consulted on this.

- Pete Rowley circulated a few articles by John Anderson that are available as UGS publications, and are also contained in the geologic bibliography for CEBR.

- Dave Sharrow mentioned that a new water well will be drilled on a fault trace near the visitor center observation platform; well logs generated from this activity will be of interest to GRD, WRD and CEBR.

GEOLOGIC HAZARDS

- The main geologic hazard discussed for CEBR centers around overlooks and fractures within the Claron Formation and how safe they are. It was agreed that all overlooks should be monitored for fracturing. Tom Henry would like some assurances from geologists about the stability of the overlooks.
- Siting facilities is also a major issue because of the fractures and potential for sloughing; these areas should be monitored for growth and potential danger.

POTENTIAL RESEARCH TOPICS FOR CEDAR BREAKS NP

It was mentioned by Tom Henry that the **Thomas Bill** is emphasizing research by local cooperators that provides information to management and is applicable to interpretation of resources. Integration of this with SUU should be taken advantage of. For a quick review of the Thomas Bill go to the following website at:
http://rs9.loc.gov/cgi-bin/bdquery/z?d105:SN01693:|TOM:/bss/d105query.html|

A list of potential research topics includes studies of the following:

- A detailed study of the Claron Formation
- Study chert distribution around CEBR as it has numerous cultural implications as well
- Develop the fire history from bogs for the last 20,000 years; Lowder Creek goes back 17,000; Red Valley 11,000; 3000 for Alpine Pond.
- Study of the groundwater system; there is lots of precipitation and little coming out of the rocks; where is it going? CEBR is especially concerned about a drinking water supply and enough to flush toilets
- In relation to the groundwater is a relatively unexplored cave and karst system that could use additional investigation; surface sinkholes suggest a well-developed system that should be studied; consult with Ron Kerbo (NPS-GRD Cave Specialist)
- Look at surface water in relation to forest canopy; decreased canopy should increase evapotranspiration
- Look at discharge rates of surface water
- Glacial/megabreccia needs investigation around Brian Head peak; nothing published by the people Grant mentioned (Gary Player)
- Isom Formation Study
- Study clustered vegetation and relation to the bedrock strata; geologic controls on locations of vegetation
- Study of rates of erosion and fractures along visitor overlooks
- Any CEBR/BRCA joint research possibilities should be lumped (Claron, erosion rates)

- Catalog unique geologic features; obtain GIS data for unique geologic features of CEBR; Dave Maxwell has students that are required to do research and he can offer their assistance like they're doing at BRCA. SUU may become a center of GIS excellence in association with Trimble Navigation
- Consult with John Anderson on any ideas he may have for research
- Attempt to better understand the dune/mud deposits on the rim shown by Laird Naylor during the field trip; geology and archeology interact here
- Better understand the role of CEBR in the transition between the Basin and Range and Colorado Plateau physiographic provinces; develop interpretive display at CEBR or Brian Head for this

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ACTION ITEMS

Many follow-up items were discussed during the course of the scoping session and are reiterated by category for quick reference.

Interpretation

- More graphics and brochures emphasizing the transition between the Basin and Range and Colorado Plateau targeting the average enthusiast should be developed. If Cedar Breaks NP needs assistance with these, please consult GRD's Jim Wood (jim_f._wood@nps.gov) or Melanie Moreno at the USGS-Menlo Park, CA (mmoreno@usgs.gov).

UGA Guidebook

- Attempt to plant the seeds of this concept to other states for similar publications involving local area geology. Such publications are especially useful for the GRI

Paleontological Resources

- Consult with Vince Santucci on the likelihood of a full paleontological survey for CEBR

Geologic Mapping

- Maintain UGS-USGS-NPS cooperation to reap all possible products from existing USGS BARCO work to benefit the NPS GRI

- USGS address issues relating to funding salaries and other work to ensure BARCO products can be published

- USGS develop for SUU a priority list of quadrangles to digitize and complete field mapping, as well as associated estimates of time and material costs

- Pete Rowley prepare a 2-tier cost proposal for his services to complete geologic field mapping of area quadrangles

- Attempt to obtain letters from the CEBR and ZION superintendents requesting the services of the USGS to complete geologic mapping of quadrangles of interest for this region. The UGS has requested similar favors of the USGS in the Marysvale area.

- Grant Willis needs to make sure that the Navajo Lake quadrangle can be transferred to SUU for digitizing since it is part of an existing agreement.

Natural Resource Data Sources
- Consult with Steve Robinson to see if ProCite database is in place for CEBR

Miscellaneous
- Dave Sharrow would like to receive a "contact list" for UGS staff from Grant Willis
- Review proposed research topics for future studies within Cedar Breaks NP
- Make contact with USGS GIS person Jeremy Workman to develop relationship with NPS GIS projects
- Have conference call with Gregson, Heise, Connors and Maxwell to discuss potential future projects, including possible digitization of the BRCA maps by Bill Bowers (1990)

APPENDIX A
Cedar Breaks NP Geological Resources Inventory Workshop Participants *July 15-16, 1999*

NAME	*AFFILIATION*	*PHONE*	*E-MAIL*	Field Trip	Scoping Session
Bruce Heise	NPS, Geologic Resources Division	(303) 969-2017	Bruce_Heise@nps.gov	x	x
Steve Fryer	NPS, Natural Resources Information Division	(970) 225-3567	Steve_Fryer@nps.gov	x	x
Tim Connors	NPS, Geologic Resources Division	(303) 969-2093	Tim_Connors@nps.gov	x	x
Pete Rowley	USGS	(435) 865-5928	prowley@usgs.gov	x	x
Grant Willis	Utah Geological Survey (UGS)	(801) 537-3355	nrugs.gwillis@state.ut.us	x	x
Dave Maxwell	SUU, GIS	(435) 865-8313	maxwell@suu.edu		x
Dave Sharrow	NPS-CEBR, Hydrologist	(435) 586-9451	Dave_Sharrow@nps.gov	x	x
Steve Robinson	NPS-CEBR, Ranger	(435) 586-9451	Steve_Robinson@nps.gov	x	
Tom Henry	NPS-CEBR, Superintendent	(435) 586-9451	Tom_Henry@nps.gov		x
Stan Hatfield	SUU, Geology Dept.	(435) 865-8160	hatfield@suu.edu	x	x
Laird Naylor	UT BLM; formerly CEBR Archeologist	(801) 977-4357	lnaylor@ut.blm.gov	x	x
Danielle Rousseau	NPS, Geologic Resources Division	(303) 987-6925	Danielle_Rousseau@nps.gov	x	x
Michael Hozik	Richard Stockton College of NJ	(609) 652-4277	Hozikm@loki.stockton.edu	x	x
Christy Stauffer	USDA FS	(435) 865-3242	Cjstauffer@netutah.com	x	
Bill Case	UGS, Extension Services	(801) 537-3340	Nrugs.bcase@state.ut.us	x	

APPENDIX B
Overview of Geologic Resources Inventory

The NPS Geologic Inventory is a collaborative effort of the NPS Geologic Resources Division (GRD) and Inventory and Monitoring Program (I&M) with assistance from the U.S. Geological Survey (USGS), American Association of State Geologists (AASG), and numerous individual volunteers and cooperators at NPS units, colleges, and universities.

From the perspective of the servicewide I&M Program, the primary focus (Level 1) of the geological inventory is

1. to assemble a bibliography of associated geological resources for NPS units with significant natural resources,

2. to compile and evaluate a list of existing geologic maps for each unit,

3. to develop digital geologic map products, and

4. to complete a geological report that synthesizes much of the existing geologic knowledge about each park. The emphasis of the inventory is not to routinely initiate new geologic mapping projects, but to aggregate existing information and identify where serious geologic data needs and issues exist in the National Park System.

The NPS Geologic Resources Division is an active participant in the I&M Program and has provided guidance and funding in the development of inventory goals and activities. GRD administers the Abandoned Mine Lands (AML) and Geologists In Parks (GIP) programs which contribute to the inventory. NPS paleontologists, geologists, and other natural resource professionals also contribute to inventory planning and data. A major goal of the collaborative effort is to provide a broad baseline of geologic data and scientific support to assist park managers with earth resource issues that may arise.

For each NPS unit, a cooperative group of geologists and NPS personnel (the Park Team) will be assembled to advise and assist with the inventory. Park Teams will meet at the each NPS unit to discuss and scope the geologic resources and inventory, which is the subject of this report. If needed, a second meeting will be held at a central office to evaluate available geologic maps for digital production. After the two meetings, digital geologic map products and a geologic report will be produced. The report will summarize the geologic inventory activities and basic geology topics for each park unit. Due to the variety of geologic settings throughout the NPS, each report will vary in subject matter covered, and section topics will be adapted as needed to describe the geologic resources of each unit. Whenever possible the scientific sections of the report will be written by knowledgeable cooperators and peer reviewed for accuracy and validity.

APPENDIX C
Cedar Breaks NM Index of Quadrangle Maps, *1:24,000 scale*)